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| 09/545,110 | 04/06/2000 | Thorsten B. Lill | 3117/SILICON/MBE | 9276 |

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EXAMINER

PADGETT, MARIANNE L

| ART UNIT | PAPER NUMBER |
|----------|--------------|
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1762

DATE MAILED: 07/30/2003

12

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/545,110

Applicant(s)

Lill et al

Examiner

M.L. Padgett

Group Art Unit

1702

—The MAILING DATE of this communication appears on the cover sheet beneath the correspondence address—

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, such period shall, by default, expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- ☒ Responsive to communication(s) filed on _____
- ☐ This action is **FINAL**.
- ☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- ☒ Claim(s) 1, 7-9, 13-16, 18, 20-28, 30-37, 78-90 + 102-108 is/are pending in the application.
- Of the above claim(s) 9, 14, 15-16, 18, 22 (thickness was amended) is/are withdrawn from consideration.
- ☐ Claim(s) _____ is/are allowed.
- ☒ Claim(s) 1, 7-8, 13, 18, 20-21, 23-28, 30-37, 78-90 + 102-108 is/are rejected.
- ☐ Claim(s) _____ is/are objected to.
- ☐ Claim(s) _____ are subject to restriction or election requirement

Application Papers

- ☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.
- ☐ The drawing(s) filed on _____ is/are objected to by the Examiner
- ☐ The specification is objected to by the Examiner.
- ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119 (a)-(d)

- ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119 (a)-(d).
- ☐ All ☐ Some* ☐ None of the:
- ☐ Certified copies of the priority documents have been received.
- ☐ Certified copies of the priority documents have been received in Application No. _____
- ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a))

*Certified copies not received: _____

Attachment(s)

- ☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____
- ☒ Notice of Reference(s) Cited, PTO-892
- ☐ Notice of Draftsperson's Patent Drawing Review, PTO-948
- ☐ Interview Summary, PTO-413
- ☐ Notice of Informal Patent Application, PTO-152
- ☐ Other _____

Office Action Summary

Art Unit: 1762

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 6/10/03 has been entered.

2. Newly submitted claims 9, 14, 15-16, 18 and 22 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: they are directed to the non-elected species concerning thickness

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 9, 14-16, 18 & 22 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

3. Claims 20-21 & 107-108 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 20-21 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claims 20-21 are dependant from canceled claim 19, hence are incomplete or unclear in context.

The rejection from section 2 of Paper No. 5 is maintained. As noted in the advisory action, as claimed the "slope criteria" have no clear or necessary relationship to the other claim limitations. The claims only require generation of "a signal", this need only be one point, and

Art Unit: 1762

has no necessary slope. Also, the signal is generated from either the under laying or overlaying material, and can concern any property thereof, including physical slope, which could be what "slope criteria" reference, its too unclear or disjointedly phrased to be necessarily determined. Applicant's allege without support on page 17 of their 4/16/03 response, that "slope" is well understood in the context of signal to refer to the rate of changed of the signal overtime, however (besides the lack of support), there is NO necessary time period or any change in any signal in the claims as written, so the claim lacks the context to even apply such a definition, if support was available. While the signal could be the electronic trace applicants discuss on p. 18, there is no necessity that the signal of claims 107 or 108 is a trace, so one cannot require or convincingly supply the alleged definition, that is not even consistent with the requirements of the claim itself. As previously noted by the examiner, a "slope" is well understood and to refer to the relationship between two variables, relating to their change relative to each other. Anyone successfully completing algebra should know this. There is no requirement in the definition, nor in the claims that either of these variables be time as implied by applicant's arguments. As written, what variables determine the slope is indeterminable, what criteria one is applying to the indeterminable slope, of the unclear origin is further undefined, making proper examination over art essentially impossible. If applicants want the signal to be a trace that is made or changes over a period of time, then if they have support, they should claim what they mean. Specification page 29 would appear to be a good starting point, but does not provide necessary meaning to the present claim language.

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Art Unit: 1762

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 23-28 & 30 remain rejected under 35 U.S.C. 102(b) as being anticipated by Busta et al as discussed in Section 11 of Paper No. 3 & section 8 of Paper No. 5.

Note that claim 23 is an independent claim from which 24-28 and 30 depend that have never been amended and do not contain the limitation discussed on pages 22 and 23 of the response, hence the arguments against the applicability of Busta et al to these claims is not convincing.

6. Claims 23-28 and 30-37 remain rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Brooks et al.

Brooks et al was discussed on pages 12 and 13, section 14 of Paper #3, with a note concerning previous changes also not added to these claims in section 11 of Paper No. 5 (page 5). Again, these claims remain unamended; i.e. do not contain the dynamic variance limitations discussed on pages 27-28. With respect to applicant's arguments on claim 23, Brooks is taking

Art Unit: 1762

continuous measurements, so plural signals are generated, and as the claims are presently written, it is irrelevant if while detecting plasma emissions or reflected light, any given signal also detects the other, as the claims are sufficiently broadly written to be inclusive of such. There are also two laser systems (15, 21) and photodiode detectors (20, 26) being employed, so there are multiple ways to read plural signals, which meet the criteria claimed, if not those implied by applicant's arguments.

7. Claims 23-28 and 30-35 remain rejected under 35 U.S.C. 102(b) as being clearly anticipated by Schoenborn, as discussed on pages 13-14, section 15 of Paper No. 3, with further notes on page 5, section 12 of Paper No. 5.

With respect to applicants' arguments on Schoenborn and claim 23 (and presumable 24-28 and 30-35 also) applicants' attention is directed to figure 3 (discussed, col. 5, lines 35-54) that shows the data points for many signals that contain plasma emission intensities. Figures 2 (discussed col. 2, lines 24-35) is the results of measurements taken at 436 nm and given % reflectively. Also, see Fig. 5 for plasma emission intensity signals (col. 6, lines 10-36+) at 436 nm. Therefore, while only one wavelength is measured here as pointed out by applicant, it is clear that it includes reflective light as well as that only coming from the plasma, and there are certainly plural signals that meet claimed criteria. These very broad claims, read on many possibilities, including that set forth by Schoenborn. Applicants' discussion appears to be directed to requirements not necessitated by the current claim language.

8. Claims 36-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schoenborn as applies to claims 23-28 and 30-35 in the above discussion and in Paper No. 3, section 15.

While Schoenborn differs by not discussing the use of a computer having memory as claimed, their continued reference to "in-line" or "real-time" determinations and monitoring

Art Unit: 1762

process (col. 3, line 46-50; col. 4, line 8-10; col. 6, line 37-45; col. 7, lines 45-50; etc.) and particularly the "in-line real time analysis module" (Fig. 6B; col. 13, lines 3-24), would have been suggestive to one of ordinary skill in the art that the process of Schoenborn was being and was intended to be run by a computer as claimed, because the controls, qualifications, calculations, etc, required to be made and monitored, could not have been done as taught by solely a human operator. Use of a computer with such real-time, in-line processes is essentially an understood necessity, implied by the language of the patent.

9. Claims 1, 8, 13, 23-24, 27-28, 31, 34, 37, 78-79, 82-84, 87 and possibly 107-108 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Angell et al (PN 5,288,367).

Claims 7, 25-26, 30, 32-33, 80-81, 85-86, 88-90 and 102-106 are rejected under 35 U.S.C. 103(a) as being unpatentable over Angell et al.

Angell et al teach monitoring light wavelengths for plasma etching processes to determine the end point, where for an initial etching run the entire spectrum of the optical emission spectrometer is monitored and recorded to determine which wavelength(s) produce useful variability from maximum to minimum values to be able to determine the end point of the process, in this case the etching. Those variables for the chosen wavelength correspond to applicants' claim and definition of dynamic variance. The event/property determined by Angell et al is completion of etching, although it is further noted that given a known initial condition (i.e. thickness of material being etched), this end point determination would obviously correspond to a thickness determination of etched material (i.e. non-etched species of thickness, that corresponds to claims 9, 14, 15-16, 18 (maybe 20-21) and 22). In Angell et al, see the abstract; figures; col. 1, lines 5-24; Summary; col. 3, lines 24- col. 4, line 24 and line 63- col. 5, line 20+; col. 6, line 30-50; col. 7, line 1- col. 8, line 8; and claims, esp. 1, 8-12, 19-23 and 30-33.

Art Unit: 1762

Note that while Angell et al do not discuss "non-polarize radiation", the emissions from plasma inherently read on this limitation. Also, while radiation or wavelengths reflected off the substrate are not discussed, the light detected from the plasma would have been expected to include both unreflected light emitted by the plasma; plus that which was emitted then reflected from the substrate. Whether or not the selected wavelength comes from a plasma species that changes or a change in reflectance is not necessitated by applicants' claims, nor does Angell et al worry about determining the cause of the wavelength's variable intensity, just that it is large enough, and quick enough to be useful for etching end-point determination.

Angell et al does not use the nomenclature of overlaying and underlaying materials to describe their substrate 15, however a material is being etched off it, and it is described as the surface of the wafer having unmasked regions, hence implicitly suggesting layers of substrate, material to be etched and mask. Alternately, it would have been obvious to one of ordinary skill in the art to employ such a substrate structure to be treated, given Angell et al's teachings. Angell et al discloses use of computer 50 for monitoring and their taught calculations and determinations, which given the nature of computers, i.e. that they run on programs in their memories, etc., inherently includes the computer programming, memory or code language used in applicants' claims. Alternately, it would have been obvious to one of ordinary skill in the computer art, to realize that these components or features must be present and used, in order for Angell et al teachings and computers to be functional.

Angell et al explicitly teach end point detection, and does not discuss detecting onset of a reaction, however the types of changes in emission that will indicate an end point, i.e. sudden or fast variation of a wavelength(s), is the same concept whether one is starting or stopping a process, both indicate change in this previous plasma emission state, hence it would have been

Art Unit: 1762

obvious to one of ordinary skill in the art to employ the basic technique for any change with a significant variable intensity wavelength.

While the Angell et al discussion is directed to specifically etching end point determination, the technical field (col. 1, lines 5-8) specifically suggests that it is for use during manufacture of products, such as integrated circuit chips, hence in order to be industrially practical, one of ordinary skill in the art would have expected the detection to be tied in with the over all process, hence the computer therefore, and removal of the substrate from the etching chamber after detected completion, would have been a standard component of automated processing as taught by Angell et al's technique. Use in manufacturing also implies treatment of plural substrates by the taught process, hence such would have been similarly obvious.

It is further noted, given applicant's discussion on what "slope criteria" are intended to mean, that the procedure of Angell et al would read on claims 107-108, since the time trace of this reference, their minimum and maximum values can be said to relate to slope thereof, and sequences are definitely employed.

10. The Japanese reference represented by the abstract and figure Watanabe (JP 404094533 A) appear to be directed towards an analogous process to that of Angell et al, but the reference as printed from/delivered by the computer was incomplete. Dolins et al employs a process similar to Angell et al, but does not test all wavelengths, and specifically filters out all wavelengths, expect that/those corresponding to a chosen molecule, and also monitors the plasma for aberrations, not just the end point. Le et al, is similar to Angell et al, but appears to use the relative change of two different wavelengths with respect to each other as the end point detection. Note the Fig. 2 x-y-z plot of intensity verse time verses wavelength for plasma emission over time of the process.

Art Unit: 1762

11. Claims 1, 8, 13, 23-24, 27-28, 31, 34-37, 78-79, 82-84, 87 and (107-108) are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Buck et al.

Claims 7, 25-27, 30, 32-33, 80-81, 85-86, 88-90 and 102-106 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buck et al.

Buck et al has essentially equivalent teachings to Angell et al for purposes of the claims as written. In Buck et al, particularly see the abstract; Figures 1-3; col. 1, lines 10-35; col. 2, lines 15-42; col. 3, line 1- col. 4, line 43, particularly col. 4, lines 37-49, where the photodetector is noted to be pointed at the plasma near the wafer surface, hence directed at any reflected wavelengths/frequencies. Also note claims, especially those directed to light, such as claim 7 which specifies use of a broad range of wavelengths monitored for amplitude variation by a photodetector; although the other possible variations that monitor audio-frequency or infrasonic variations may read on the claimed radiation source, but how or whether reflections occur with these figures is not known to the examiner. Essentially the same inherency and/or obviousness arguments as applied in section 7 above, also apply to Buck et al.

12. Claims 1, 7-8, 13, 23-28, 30-37, 78-90 and 102-106 are rejected under 35 U.S.C. 103(a) as being unpatentable over Angell et al or Buck et al, in view of Brooks, Jr. et al or visa versa.

All these references are discussed above/previously. It is noted that the claims as written do not require the radiation source to be separated from the processing meanings of the process/apparatus claimed, so use of the process itself to supply the claimed radiation as in Angell et al or Buck et al is consistent with the claims as written. However, as discussed in Brooks et al, a plasma may be supplied with a separate radiation source to monitor the end point, with Brooks et al's Fig. 4 providing a time-trace analogous to those employed by Angell et

Art Unit: 1762

al or Buck et al to effect their end point detections equivalent to the claimed dynamic variance technique. It would have been obvious to one of ordinary skill in the art, that the supplied radiation with corresponding spectrometer measurements would have been effectively treated with the variant wavelength techniques of Angell et al or Buck et al, as the request time variation is already shown, and while Brooks supplies a known specific reflection/emission wavelength for a specific process, the technique of Angell et al or Buck would enable determination of optimum λ for a broad band input, enabling greater precision and determination for other plasma processes.

13. Claims 78-79, 82-84 and 87 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Kawahara et al.

Claims 1, 8, 13, 23-24, 27-28, 31 and 34-35 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Kawahara et al.

Claims 7, 25-26, 30, 32-33, 36-37, 80-81, 85-86, 88-90 and 102-106 (107-108) are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawahara et al.

In Kawahara et al, see the abstract; figures, col. 1, lines 5-16; summary; col. 4, lines 5-30 and 60- col. 6, line 12, esp. col. 5, lines 25-64; and claims, esp. 1, 4-6; etc., for use of reflected light to measure variation over time of maximum and minimum intensity values, in order to calculate deposition rate, thus the thickness deposited and when the desired thickness is reached. Note the taught RF sputtering process is a plasma process, hence plasma emissions are inherently present during the process and monitoring, so arguments as applied in Brooks are again appropriate. Arguments for obviousness of use of computers, etc., for real-time monitored, calculated and controlled processes are analogous to those applied above, as are those for "onset" monitoring. Kawahara et al do not discuss whether or not their light is "non-polarized", however, unless specified to be polarized; light is generally assumed to be

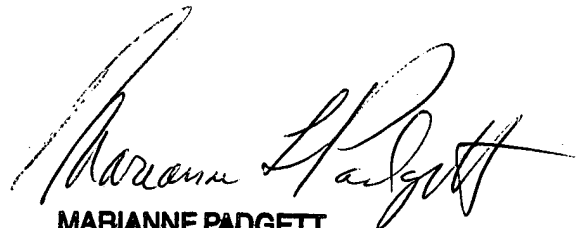
Art Unit: 1762

implicitly of non-polarized. Alternately, it would have been obvious to use common un-polarized light, as specially polarized is not required.

14. Meyer et al, Heimann et al & Sternheim et al have further teachings using intensity-time curves in monitoring. The copending patent to Grimbergen et al with overlapping inventors is noted, but if there is obviousness double patenting is unclear, as the limitation to "wavelength...absorbed in a path length" is too cryptic to be understood by the examiner.

15. Any inquiry concerning this communication from the examiner should be directed to M. L. Padgett whose telephone number is (703) 308-2336. The examiner can generally be reached on Monday-Friday from about 8:30 a.m. to 4:30 p.m.; and fax phone numbers are (703) 872-9310 (regular); (703) 872-9311 (after final); and (703) 305-6078 (unofficial).

M.L. Padgett/dh 7/25/03
July 29, 2003



MARIANNE PADGETT
PRIMARY EXAMINER